

DRAWINGS ATTACHED.



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COMPLETE SPECIFICATION.

Improvements in Mercury Button Electric Switches.

We, GENERAL ELECTRIC COMPANY, a Corporation organized and existing under the laws of the State of New York, United States of America, residing at 1 River Road, Schenectady 5, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

The present invention relates to liquid-contact switches and particularly to an improved mercury button switch of the type which are widely used for controlling residential lighting circuits.

The vast majority of the mercury button switches of the prior art have included a ceramic barrier sandwiched between a pair of hat-shaped metal shells of chrome-iron. The assembly was hydrogen filled at a pressure of approximately three atmospheres, and hermetically sealed by a glass ring encircling the rims of the shells and bonded to the periphery of the ceramic barrier. A small opening is formed through the barrier at a point that is radially offset from the geometric center of the barrier, which center coincides with the pivotal axis of the button. A quantity of mercury is included in the button as a liquid contact medium for electrically connecting the two metal shells to close the switch circuit. This is accomplished when the button is rotated to dip the through opening in the barrier into the mercury so that the mercury that was once separated into two pools by the barrier will flow through the opening and merge into one body of mercury. To open the circuit, the procedure is reversed and the button is rotated in the opposite direction to lift the through opening out of the mercury, thereby electrically

isolating the mercury into two separate pools.

Such a mercury button switch is described for instance in the U.K. Specification No. 462,527. This Specification also shows that the barrier member has a cavity at both sides in addition to the mentioned through opening, which cavities are disposed exactly diametrically opposite to the mentioned through opening so as to receive and to discharge part of the mercury during operation in order to decrease the angle through which the switch has to be turned for switching off and switching on the current.

It is the object of the present invention to improve the performance of the known switch and above all to further reduce the angle through which the switch has to be turned for its operation.

Therefore, a turnable mercury button switch according to the invention comprises a sealed metal housing, a mercury filling within the housing so as to partly fill the latter, and a barrier member extending at right angles to the axis of rotation so as to form two chambers within the metal housing, the barrier member having one eccentrically disposed through opening which allows the two pools of mercury in the said two chambers to join when the button switch is turned into its "On" position and which comes to lie above the level of the mercury filling when the button switch is turned into its "Off" position, and at least one eccentrically disposed cavity located at one side of a plane through the centre of the through opening and the rotary axis of the button switch with its edge tangential to the plane at a position diametrically opposite to said through-opening.

As a result of the stated relationship between the positions of the through-opening

and of the cavity in the barrier member, it is only necessary to turn the switch through a lesser angle than before to obtain the beneficial effect when the mercury enters the cavity during the opening of the switch or when it is discharged from the cavity during the closing of the switch.

The operational angle of the mercury button switch according to the invention can be reduced still further by roughening the surfaces of the switch which are in contact with the mercury and/or by filling the switch with a composite gas comprising hydrogen and an inert gas having an inherently poor dielectric recovery characteristic, such as argon.

The invention will be better understood from the following description taken in connection with the accompanying drawings wherein:—

Figure 1 is an isometric view showing a mercury button switch embodying this invention;

Figure 2 is a cross-sectional elevational view taken through the center of the switch on line 2—2 of Figure 6;

Figure 3 is a left end view of the switch of Figure 2;

Figure 4 is an exploded isometric view of the various parts of the switch which confine the mercury and form a complete assembly;

Figure 5 is a right end view of the dielectric liner which fills most of the interior of the switch enclosure and serves to control the flow of mercury during the operation of the switch;

Figure 6 is a cross-sectional elevational view taken on the line 6—6 of Figure 2, with the removal of the closed end of the metal shell to observe the position of the mercury as the switch is turned counterclockwise to the ON position;

Figure 7 is a cross-sectional elevational view similar to that of Figure 6 after the switch has been turned clockwise to its OFF position;

Figures 8, 9 and 10 are isometric views showing the dielectric liner and the mercury as the mercury would be confined in the metal enclosure, although the enclosure is not shown;

Figure 8 represents the OFF position of the switch;

Figure 9 shows the mercury as the two pools enter the through opening in the partition of the dielectric liner, but before the pools merge into one;

Figure 10 is a view showing the switch in the ON position; and

Figure 11 is a graph showing the relation between the number of grams of mercury in the switch versus the throw of the switch or the differential angle between the ON and the OFF positions, for two differently designed switches.

Referring in detail to the drawing, and in particular to Figures 1 and 4, 10 represents the completely assembled mercury button switch embodying this invention. The switch has a metal enclosure formed by a cylindrical shell 11 that has a closed end 12 and an open end that is closed by a separate cover plate 13 welded to the shell. The open end of the shell 11 has an outwardly extending flange 14 that has its outer edge rolled over at 15 to establish the flange 14 as a recessed seat for supporting the cover plate 13 in a centered position prior to the welding operation. The inner face of the cover plate 13 has a welding projection 16 around the rim of the plate which is melted during the projection welding process to form a hermetic seal between the shell 11 and the cover plate 13.

The metal shell 11 constitutes one electric terminal of the switch and the second terminal is a metal pin 20 which extends through a glass window 21 in the central portion of the cover plate 13. The innermost end 23 of the terminal 20 lies as if it were flattened against the inner side of the glass window 21, and it is much larger in diameter than the diameter of the pin, as is best seen in Figure 2.

The principal element of the switch is a dielectric liner 25 of ceramic material that is of tubular shape and closely interfits within the metal shell 11. The liner 25 has a transverse central partition 26, as best seen in Figure 2, which serves to divide the enclosure into two compartments for retaining the mercury. Looking at the left end cross-sectional views of Figures 6 and 7, the partition 26 is shown with a circular through-opening 27 and a reservoir or cavity 28 in only one side of the partition. The through opening 27 is designed to permit the mercury on both sides of the partition to flow together at the center of the opening and complete an electrical circuit between the metal shell 11 and the head 23 of the terminal pin 20. It is desirable that a button switch, to be usable in a wall-mounted position, should be capable of operation in less than a maximum angle of throw of the order of 20° from an ON position to the OFF position. Accordingly, the through opening 27 is located as far as possible away from the geometric center axis of the metal shell, as is shown in Figure 6. This establishes the through opening 27 not only through the partition 26 but also through the tubular portion of the liner 25.

There is an important reason for establishing the reservoir or cavity 28 in one side of the partition 26. It is strategically located with its lower edge on a plane through the center axis of the shell and the center axis of the through opening 27, as shown in Figure 6. Turning now to Figures 8 to 10, as the switch is rotated in a counterclockwise direction, as seen in the drawings, the

through opening 27 will begin to sink below the level of the mercury pools 29 and 30. This begins to remove the obstruction between the two pools and they start slowly to enter the through opening 27 with rounded frontal surfaces 31 and 32, respectively, as depicted in Figure 9. As these two bodies of liquid mercury come into contact, a high inrush current will immediately vaporize the frontal surfaces of the mercury bodies. Final circuit closure might occur only after two or more such vaporizations or explosions. The purpose of the reservoir is to dump the last traces of mercury out of the reservoir and into the mercury stream at the opportune moment when the two pools of mercury begin to merge at the center of the through opening 27. This dumping action will increase the kinetic energy of one of the moving mercury bodies and deter the local explosive effects of the contacting surfaces of mercury. When the switch is turned in the opposite direction, the reservoir 28 again serves to increase the kinetic energy of one of the moving mercury bodies as they begin to separate. The reservoir performs this function by absorbing a quantity of mercury just at the opportune time when the two bodies of mercury separate from each other.

There is a dimple 35, in line with the through opening 27, pressed into the inner surface of the closed end 12 of the metal shell. The dimple is shown as an embossment 36 in the left-hand end view of the shell in Figure 3. The purpose of the dimple is to provide an inclined surface to direct the arc from the source of the arc through an extended path of cooling gas atmosphere.

In operation, a switch handle (not shown) is seated on the outer cylindrical side of the shell 11 to oscillate the button structure about the central axis of the shell between an ON and an OFF position. The switch handle must be in driving engagement with the shell so that movement of the handle will move the button. This driving engagement is created by a short indentation 37 pressed inwardly of the shell and lying parallel to the central axis of the shell for receiving a projection on the bottom of the switch handle, as is well understood by those skilled in this art. There not only must be a particular alignment between the switch handle and the metal shell; there must also be alignment between the metal shell and the ceramic liner 25. This is absolutely necessary since the liquid mercury always seeks its own horizontal level within the liner. Accordingly, the through opening 27 in the partition of the liner must be accurately positioned with respect to the level of the mercury for obtaining the minimum angle of throw. Hence, the indentation 37 is used for a second purpose, that of indexing the ceramic liner 25, as seen in Figures 4 and 6. The liner 25 has a longi-

tudinal groove 38 which receives the inward projection of the indentation 37 of the metal shell, as best seen in Figure 6. The indentation is made short so that the liner may be first positioned in the shell by an automatic assembly machine, and then turned until the groove 38 aligns itself with the indentation 37 to permit further entry of the liner within the shell.

The button switch of the present invention is designed to be substantially the same size as the button switches of the prior art. Also, the button switch is to be incorporated in a switch housing of standard size which in turn is covered by a standard faceplate having a rectangular opening for the switch handle. In practice, the switch handle has a maximum throw from ON to OFF of approximately 40° before it strikes the edge of the opening in the faceplate. There are however several uncontrollable variables that may arise and have a cumulative result to change the operating conditions of this switch. First, if too little or too much mercury is poured into the button the throw of the button will be increased. Secondly, the contamination of the mercury will have a similar result. Thirdly, if the contacts within the switch housing or the mounting strap for the switch are misaligned, the button will be cocked at an undesirable angle and its characteristics will change. Fourthly, if the wall or the switch housing within the wall is not perpendicularly arranged with respect to a horizontal plane, the switch housing and hence the button will be leaning at an angle to the horizontal. Accordingly, a decision has been made to limit the maximum throw of the button to a maximum of 20° to accommodate the many variables mentioned above so as to provide a switch that will operate consistently within a permissible angle of 40°.

There is always a certain amount of looseness between the liner and the shell in order to avoid a forced fit which might crack the ceramic material during the assembly. This looseness, however, tends to vary the operating angle of the switch handle with respect to a horizontal plane. It will be understood that if the throw of the handle is excessive, the handle will strike the end of the opening in the faceplate before the switch is operated, thus preventing its operation. This loose fit between the liner and shell has been retained during the assembly of the liner, but it has been eliminated when the liner is finally assembled by the use of a slight embossment 39 in the end wall 12 of the shell which is shown from the back in Figure 3. This embossment mates in a conical hole 40 in the adjacent edge of the tubular liner 25. This embossment 39 and mating conical hole 40 are generally diametrically opposite the indexing arrangement formed by the groove 38 and the indentation 37 of the shell as shown

in Figure 6. These two interfitting arrangements between the ceramic liner 25 and the metal shell 11 substantially prevent any relative movement between the two elements, once the switch is assembled.

A critical factor, that was discovered after innumerable sample testing and design changes, is the necessity for a tight seal between the ceramic liner 25 and the glass window 21 of the cover plate 13. The terminal pin 20 constitutes one terminal of the switch while the metal shell 11 and annular ring 22 of the cover plate 13 form the second terminal. If a reliable seal between the mating surfaces of the liner 25 and the glass window 21 is lacking, minute droplets of mercury will penetrate this area and cause unplanned and unwanted closure of the circuit from the flattened head 23 of the terminal pin to the metal ring 22 of the cover plate. The normal dimension tolerances for the ceramic liner, the glass window and the metal shell make it improbable that a direct engagement of the ceramic across the inner face of the glass and the metal ring will ever seal this area from the penetration of high energy mercury vapors which are created as the switch operates. The ceramic liner which is required to seal against the glass window depends for sealing pressure on the following part dimensions:—

1. The depth of the drawn metal shell 11.
2. The height of the welding projection 16 around the rim of the metal cover plate 13.
3. The volume of metal that is melted in the projection welding process.
4. The level of the inner face of the glass 21 as it is sealed to the metal ring 22 of the cover.
5. The length of the tubular ceramic liner 25.

Dimensional variations in items 1, 2 and 3 above can be controlled within reasonable limits by using careful manufacturing procedures. The dimensions of items 4 and 5 above can never be controlled precisely, regardless of manufacturing process. In item 4 above it is imperative that the inner surface of the glass and the metal ring 22 be in the same plane, precisely, if a non-resilient ceramic liner is to seal securely. When glass is melted and bonded to the metal ring, a meniscus is formed in the glass which is concave. This meniscus may form to the flat side of the metal ring or may fall short of this position, depending on the many uncontrollable variables involved in processing the compression seal of the glass within the metal ring. A few of the uncontrollable variables would be the firing temperature and rate of change of temperature in the furnace, the atmosphere in the furnace, dimensions of glass preform, density and particle size of glass preform, size of the opening in the

metal ring, and density and distribution of the oxide film within the metal ring opening.

Similarly, in item 5 above the length of the tubular ceramic liner is variable for the following reasons:—

1. Chemical purity of the ceramic powders.
2. Proportions of, and characteristics of the ceramic fluxing material.
3. Rate of temperature change in firing the ceramic.
4. Atmosphere in the furnace.
5. Position of the parts on the firing saggers.
6. Original unfired dimensions of the pressed parts.
7. Density of the unfired parts.
8. Granular structure of the fired parts.

The above technical obstacles to a reliable non-resilient seal between the ceramic liner 25 and the inner face of the cover plate 13 have fostered the use of a resilient annular seal or washer 43 of special design that is compressed between these parts, as shown in Figures 2 and 4 of the drawings. The most satisfactory material that has been used to date for this washer 43 has been silicone rubber, although several less temperature-resisting materials such as natural rubber have also been found acceptable. The silicone rubber washer 43 is approximately .030" (= $\frac{3}{8}$ mm.) thick and the engaging parts are designed to compress this rubber about 50% under conditions of the nominal values of all dimensions. Thus, wide variations in part dimensions are possible without diminishing the effective seal at the inner face of the cover plate 13. This washer, however, will be positioned near the through opening 27 in the partition 26. This area is subject to intense local heating when the switch is operating at its full load capacity. It has further been discovered that a narrow projecting rim or flange 44 on the end of the tubular liner 25 is most effective in screening the high temperature arc from the silicone washer. This rim 44 is substantially equal in internal diameter to the smallest diameter of the tubular liner, as is best seen in Figure 4. The washer 43 slips closely over the rim 44 so that when the cover plate 13 is welded to the recessed flange 14 of the metal shell, the washer will not be allowed to expand inwardly into the chamber of the switch in which the mercury is present, as seen in Figure 2. There is only a very slight air gap or clearance between the circular end of the rim 44 of the liner and the glass window 21 that separates the mercury chamber from the silicone washer, but this has caused no deterioration of the resilient seal in the exhaustive tests that have been performed to date.

An additional improvement which has been

incorporated in this mercury button switch is a low pressure composite gas-fill. In this particular design it has been found that the use of high pressure hydrogen-fill gas alone in the order of three or more atmospheres, as used in the previous button switches, is undesirable. It is true that the hydrogen gas has a distinct advantage in absorbing and dissipating the heat of the electrical arc. It has a further advantage in being chemically active to combine with any impurities liberated by the electric arc, particularly impurities which might be absorbed by the bodies of mercury to depreciate their active fluid characteristics. The energy in an electrical arc is determined by the current through the arc and the voltage across the arcing contacts. In any switching device arcs become destructive when the product of arc current and arc voltage exceed a critical limit. Hydrogen, by its nature, has a very high dielectric recovery rate. At any instant after the zero of current this recovery rate or strength is several times greater in hydrogen than it is in other common gases. Electrical contacts separated in hydrogen therefore experience this effect in the form of high arc voltages. In other words, the high dielectric recovery of hydrogen atmospheres increases the energy developed between two contacts that interrupt electrical currents in such a medium. As the pressure of the hydrogen gas is increased the dielectric recovery strength also increases as does the arc energy.

High values of arc energy are desirable as two electrical contacts are operated to open or break an electrical circuit, because these high energy levels cannot be sustained by the power source and the arc is extinguished by its own greed. However, the reverse is true in closing or making an electrical circuit; particularly with mercury circuit closures. High arc energy levels are undesirable because they contribute to multiple explosions and rebounds of the mercury pools before the circuit is established. It follows, that hydrogen at high pressures is undesirable in mercury switches, which is contrary to the theory followed in making the prior art switches.

In an alternating current switch, best advantage can be made of the device if the circuit is opened and closed during the periods when the voltage and current pass through zero. This factor becomes increasingly important when the circuit closing is accomplished by liquid contact such as liquid mercury. In a high inrush current circuit such as produced by a tungsten lamp load, it is improbable that the two pools of liquid mercury will close at a near peak of the current cycle without causing local heating that explodes or vaporizes the frontal surfaces of the mercury bodies. Such an explosion opens the electrical circuit and requires a

continued motion of the mercury pools to effect a second circuit closure. When a hydrogen atmosphere alone surrounds the mercury pools, the heat of the first explosive contact of the mercury bodies is rapidly dissipated by the hydrogen, and the excellent recovery characteristics of the gas almost instantly re-establish full line potential across the bodies of mercury which have been separated by the explosion. A second closure of these mercury pools will, therefore, occur at a voltage as great as the original closure and a second explosion is almost certain to result. It should be noted that the local explosions here described are of atomic proportions, and are not evident externally of the mercury button. Similarly, the mercury vaporized during such explosions is confined within the button assembly and quickly condenses so that there is no permanent loss of mercury fill.

The above adverse circuit-closure conditions can be avoided, particularly on high alternating current loads, with the introduction into the button switch, in addition to the hydrogen, of an inert gas which has a particularly poor dielectric recovery strength characteristic. Both argon and neon are such gases. When the argon gas is used, the first explosion of the mercury pools vaporizes some mercury and separates the bodies of mercury, but the argon gas immediately ionizes and preserves a relatively low arc voltage across the bodies of mercury. Then as the mercury pools reclose, the low arc voltage across the mercury assures a low energy closure without secondary explosions. A hydrogen filled switch usually continues reclosures until by chance a near zero point in line voltage occurs at the time of closure. The argon hydrogen fill gas provides nearly this condition at any instant of reclosure. It was found with repeated testing that a proper proportion of argon and hydrogen fill gas at a pressure of about 1.7 atmospheres results in a smaller angle of throw for the switch handle and also causes less destruction within the button due to repeated arcing on each switching cycle.

The development efforts have also discovered the importance of a "soft" anchor point for the mercury to make the angular operation of the switch consistently reliable. Such an anchor point can be established by the deposit of a small amount of silver, such as a silver paint or other noble metal, in Figure 5, to the surface of the partition of the liner so that the silver will amalgamate with the adjacent mercury pool to provide a temporary restraint for the mercury midway between its at-rest positions ON and OFF until the mercury overcomes the restraint and moves rapidly to catch up with itself in point of time. The force of coalescence between the spot of amalgamation, and the center of gravity of the mercury pool can be

determined to aid the gravity force on the mercury in effecting a consistent and stable operating angle as the button cycles between ON and OFF positions. It is apparent that if the anchor point is made very large and very secure, the anchor forces will completely exceed the forces of gravity on the mercury pool and no switch action will occur when the switch is rotated.

10 An additional feature of this button switch is a reduction in the friction forces acting on the mercury pools. It is desirable that the mercury be free moving and be devised for ready movement with the least amount of external energy; i.e., angular movement of the switch handle. The friction forces or adherence of the mercury to the ceramic liner and metal shell can be reduced if the surface area between the mercury and these parts can be reduced. This is accomplished by roughening the parts. In the case of the ceramic liner, the roughness can be developed easily by fabricating the part from coarse ceramic powders. The metal parts in turn can be roughened by sandblasting or chemical etching. The mercury pools when clean have high surface tension to prevent the liquid mercury from assuming an irregular surface that would be the image of the adjacent metal or ceramic. In other words, the smooth mercury rests only on the rough points of the supporting bodies. The contact area between the mercury and the supports is, therefore, considerably reduced from the condition where the supports have a glass smooth finish.

This action is quite evident in the graph of Figure 11 where the grams of mercury fill represent the abscissa of the graph while the ordinate is the differential angle between the extreme ON and OFF positions. Curve 1 represents a design with a smooth shell. The differential angle of the switch handle is much greater at a given mercury fill than in the situation of Curve II where the shell has been roughened by sandblasting. It is readily seen that the inclusive angle from ON to OFF positions of the button has been reduced from a low of 22° on the smooth surface to 15° on the rough sandblasted surface. No other changes were made to obtain the findings of the two curves; in fact, they were the identical parts and conditions used in both. It is also evident from this graph that the effect of the mercury fill on the differential angle is directly dependent on the size and position of the reservoir 28. In the lower fills of Curves I and II, the reservoir is not being used at all and the mercury merely pours into and out of the trough opening 27. At a point of around 3.1 grams, the reservoir is being used to best advantage when it is dumping the mercury into the through opening at the instant of circuit closure, and also in reverse at circuit interruption. In the higher fills,

above 3.3 grams, the reservoir again is not advantageous; that is, the mercury mass is so large that it pours into the reservoir before breaking the circuit. In the higher fills, the reservoir remains full during normal rotation of the button and has no effect on lowering the differential or operating angle of the switch handle. Such a study as depicted by this graph is of great assistance in developing consistent operating angles in a mercury button switch with a minimum mercury fill.

Having described above a mercury button switch with a metal enclosure, it will be readily understood by those skilled in this art that this design is well engineered so that it can easily be duplicated and assembled by automatic machinery with a negligible amount of human handling and supervision. This design represents the culmination of a tireless and expensive research and development program that has extended over a several year period after countless theories, tests and design changes, and numerous consultations with fellow scientists in all of the related branches of this art who might shed some light on the mysterious nature of mercury as an electrical contact medium. It is conceivable that other resilient seals could be substituted for the silicone washer. One possibility is a circular metal sheet that would be spaced from metal ring 22 and held tightly against the end of the liner by pressure exerted at the center of the sheet by the inner end of the terminal pin 20 to give an "oil can" effect.

WHAT WE CLAIM IS:—

1. A turnable mercury button switch comprising a sealing metal housing, a mercury filling within the housing so as to partly fill the latter, and a barrier member extending at right angles to the axis of rotation so as to form two chambers within the metal housing, the barrier member having one eccentrically-disposed through-opening which allows the two pools of mercury in the said two chambers to join when the button switch is turned into its "On" position and which comes to lie above the level of the mercury filling when the button switch is turned into its "Off" position, and at least one eccentrically-disposed cavity located at one side of a plane through the centre of the through-opening and the rotary axis of the button switch with its edge tangential to the plane at a position diametrically opposite to said through-opening.

2. A turnable mercury button switch as claimed in Claim 1, comprising such an amount of mercury that, in the "On" position, the mercury level is substantially at the height of the rotary axis of the switch.

3. A turnable mercury button switch as claimed in Claim 1 or 2, wherein the surfaces of the metal housing that are in contact with

the mercury are roughened so as to reduce the friction between housing and mercury.

4. A turnable mercury button switch as claimed in any one of the preceding claims, wherein the barrier member is made from a coarse ceramic powder so as to have a rough surface in order to reduce the friction between the barrier member and the mercury.

5. A turnable mercury button switch according to any one of the preceding claims, wherein a small deposit of noble metal is attached to at least one side of the barrier member slightly spaced from the through opening in the barrier member to amalgamate with the adjacent mercury pool and to serve as a temporary restraint or anchor point for the mercury midway between its extreme ON and OFF positions.

6. A turnable mercury button switch as claimed in Claim 5, wherein the noble metal is applied as a small amount of silver paint to one side of the barrier member.

7. A turnable mercury button switch as claimed in any one of the preceding claims having a composite gas filling comprising hydrogen and an inert gas having an inherently poor dielectric recovery characteristic, such as argon.

8. A mercury button switch as claimed in any one of the preceding claims in which the housing comprises a cylindrical metal shell forming one terminal, a cover plate hermetically sealed to the metal shell and a second switch terminal extending into and electrically insulated from the housing, and in which the barrier member is a cylindrical liner of ceramic material closely fitting within the metal shell and provided with a transverse central partition in which the said through opening and the cavity are arranged.

9. A mercury button switch as claimed in Claim 8, wherein the cover plate includes an

insulating window having the said second switch terminal extending centrally through its insulation, and wherein a sealing means is provided between one end of the cylindrical liner and the terminal insulation to produce a tight seal at the inner face of the cover between the insulating window and the liner.

10. A mercury button switch as claimed in Claim 9, wherein the end of the liner which engages the sealing means has a circular rim adjacent the internal diameter of the liner, and wherein the sealing means comprise a resilient sealing ring of high-temperature-resisting material provided around the rim and compressed between the liner and the terminal insulation, the seal being protected by said rim from the high temperature arc that is formed upon closure and opening of the mercury pools.

11. A mercury button switch as claimed in Claim 10, wherein the sealing ring is a thin silicone rubber washer forming a compression seal around the rim and is shielded from high temperature arcs by the circular rim on the end of the liner which closely fits within the center of the washer.

12. A mercury button switch as claimed in Claim 9, wherein the terminal that is assembled in the insulating window of the cover plate has an enlarged inner end of generally circular shape that lies flattened against the inner face of the window.

13. A turnable mercury button switch substantially as described with reference to and as illustrated in the accompanying drawings.

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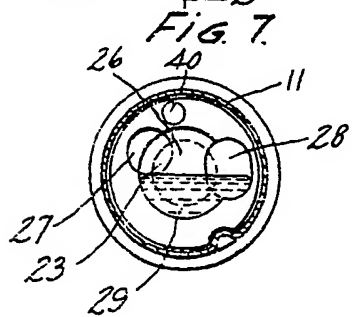
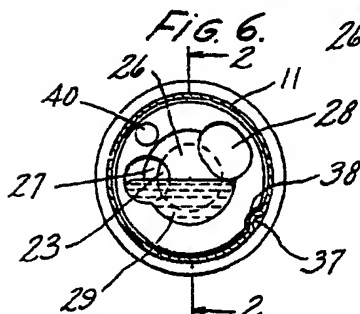
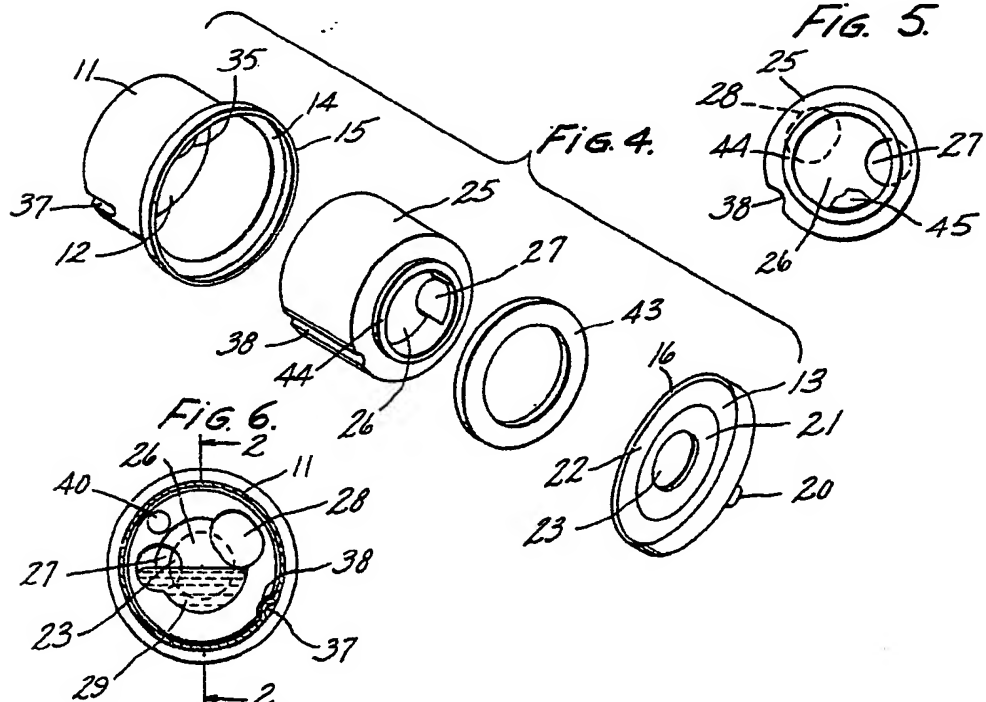
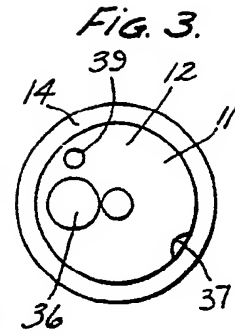
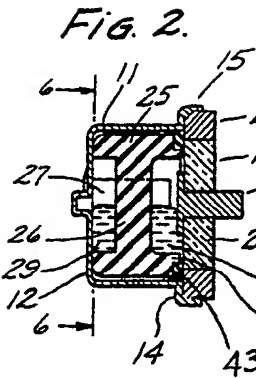
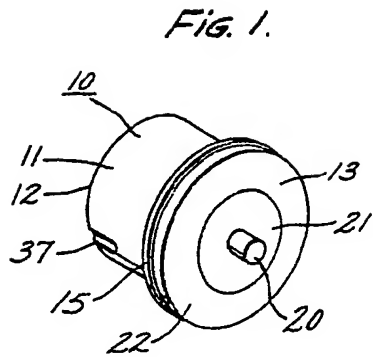


FIG. 8.

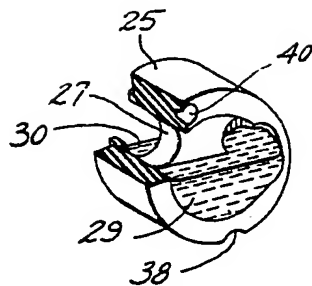


FIG. 9.

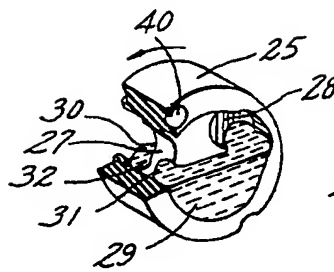


FIG. 10.

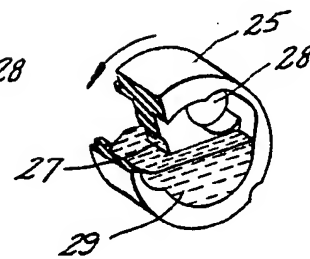


FIG. 11.

